

## SOME IMPORTANT TRANSITIONS IN SPENT FUEL

### Purpose:

This lesson will facilitate the student understanding of the fact that though approximately 90 percent of spent fuel's radioactivity will be lost within 10 years, it contains material that will continue to emit radiation for thousands of years. An understanding of this aspect of the decay process is necessary in order for students to appreciate the need for extreme caution in the handling and storage of spent fuel.

### Concept:

Radioactive materials emit radiation in the form of alpha or beta particles during the process known as radioactive decay.

### Duration of Lesson:

One 50-minute class period

### Objectives:

As a result of completion of the lesson and activity dealing with important atomic transitions in spent fuel, the learner will be able to:

1. discuss and explain that during the process known as radioactive decay, radioactive materials emit radiation in the form of alpha and beta particles; and
2. synthesize why it is necessary that extreme caution be exercised in the handling and storage of spent fuel.

### Skills:

Completing charts, discussing, interpreting charts, synthesizing

### Vocabulary:

Atomic, noble gas, nuclear reactor, nuclides, transition

### Materials:

Reading Lesson

*Nuclear Waste: What Is It? Where Is It? - Unit 1*, p. SR-9

Activity Sheets

*Table of Some Important Atomic Transitions in Spent Fuel*, p. 147

*Chart of Some Important Isotopes in Spent Fuel*, p. 149

Background Notes

*Some Decay Transitions in Spent Fuel*, p. 71

**Suggested Procedure:**

1. If you have not already assigned reading of the lesson entitled *Nuclear Waste: What Is It? Where Is It? Section 1.17 Spent Fuel*, do so at this time.
2. Review examples of decay transitions on the bottom of the activity entitled *Some Important Decay Transitions in Spent Fuel*. Instruct students to plot alpha and beta decay transitions, using the table *Some Important Atomic Transitions in Spent Fuel* to assist them.
3. Ask students to explain the significance of what they have just plotted on their charts.

**Sample Discussion Questions:**

1. Why are these elements that decay considered to be unstable?  
*(These elements are called unstable because they are in the process of stabilizing themselves by emitting gamma rays or changing into another element by emitting alpha and beta particles.)*
2. What is significant about the fact that unstable elements seek to stabilize themselves?  
*(During the process of decay these elements emit radioactivity, in the process becoming less and less radioactive until they ultimately become stable elements such as lead. The significant thing to remember about decay is that different elements stabilize at different rates; some doing so very quickly, others taking thousands of years to stabilize.)*
3. Explain the relationship of the above questions to the storage of spent fuel.  
*(When spent fuel is removed from the reactor it is stored in a deep, steel-lined, concrete pool of water inside a building at the powerplant. While the spent fuel is stored in the water it cools thermally and becomes less radioactive. During the first 3 months of storage, spent fuel loses approximately 50 percent of its radiation. After a year, it will have lost 80 percent and in 10 years, it will have lost 90 percent. However, spent fuel contains some materials that emit radiation for thousands of years; remaining potentially dangerous for a long time. Because of these different rates of decay and the resultant potential for danger, extreme caution must be exercised in the handling and storage of spent fuel.)*

**Teacher Evaluation of Learner Performance:**

Response in discussion and on the activity sheet will indicate level of comprehension.